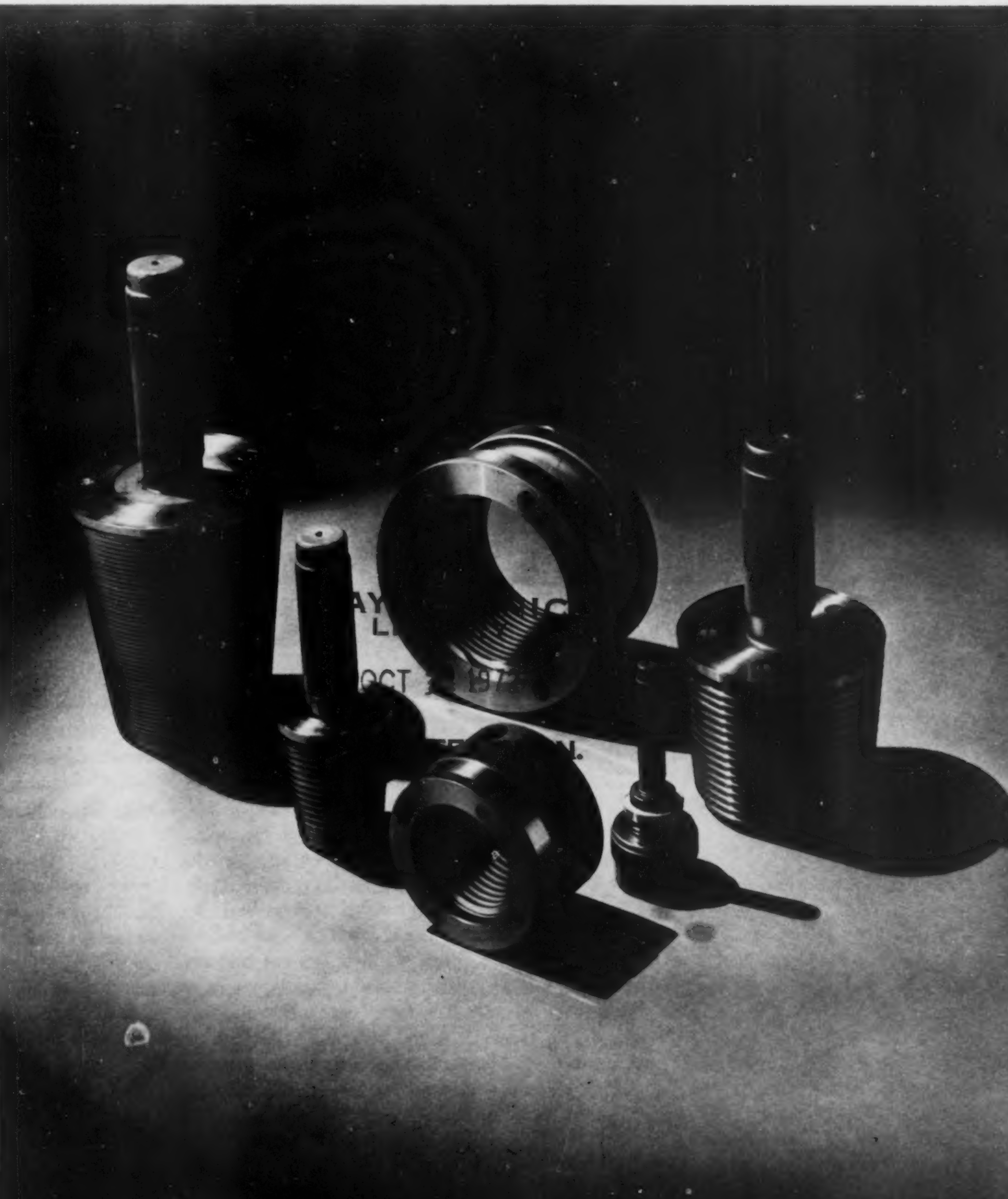
October 1972

A UNITED STATES
DEPARTMENT OF
COMMERCE
PUBLICATION

U.S.

NATIONAL BUREAU OF STANDARDS

Technical News Bulletin



UNITED
STATES
DEPARTMENT
OF
COMMERCE

NBSTAR 56(10)
229–252 (1972)

NATIONAL BUREAU OF STANDARDS

Technical News Bulletin

OCTOBER 1972 / VOL. 56, NO. 10 / ISSUED MONTHLY

CONTENTS

Nat. Bur. Stand. (U.S.), Tech. News Bull.
CODEN:NBSTAR 56(10) 229–252 (1972)

Superintendent of Documents Catalog No. C13.13:56/10

Library of Congress Catalog No. 25–26527

Cover: Shown here are some of the standard gages developed by the American Petroleum Institute and used worldwide in the petroleum industry. For a discussion of the process of standardization, see the article by Olle Sturen, Secretary General of the International Organization for Standardization, starting on page 236.

U.S. DEPARTMENT OF COMMERCE
Peter G. Peterson, Secretary

Richard O. Simpson
Acting Assistant Secretary
for Science and Technology

NATIONAL BUREAU OF STANDARDS
Lawrence M. Kushner, Acting Director

Prepared by the NBS Office of Technical Information and Publications, Washington, D.C. 20234

W. R. Tilley, Chief

Managing Editor
D. V. Baker

Contributing Editors
L. K. Armstrong, R. T. Cook, M. A. Darmstadter J. E. Kluge, C. R. Naas, A. Schach, C. N. Smith, S. A. Washburn, D. E. Webb

C. Messina, Visual Editor

The National Bureau of Standards serves as a focal point in the Federal Government for assuring maximum application of the physical and engineering sciences to the advancement of technology in industry and commerce. For this purpose, the Bureau is organized as follows:

The Institute for Basic Standards

The Institute for Materials Research

The Institute for Applied Technology

Center for Computer Sciences and Technology

Center for Radiation Research

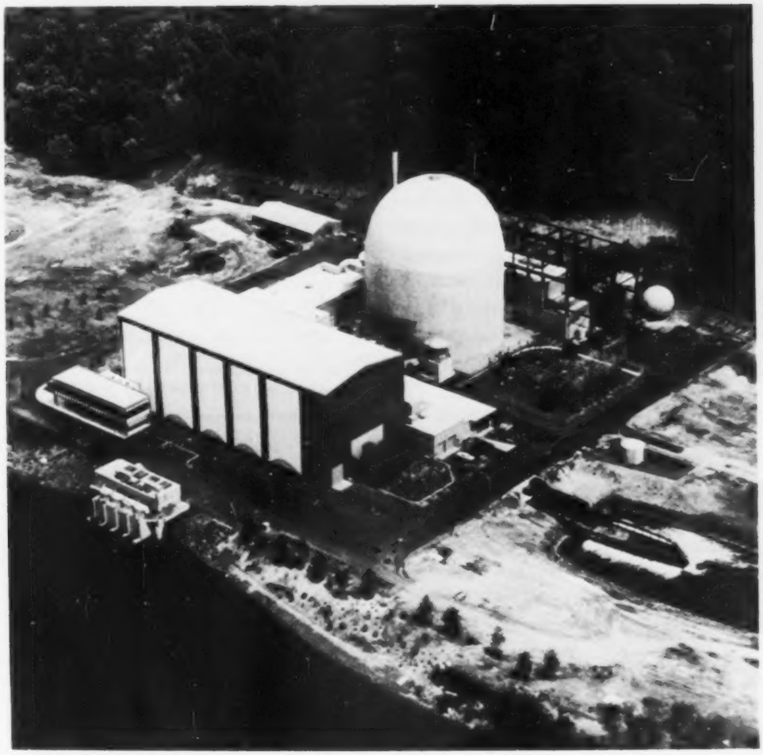
Center for Building Technology

The TECHNICAL NEWS BULLETIN is published to keep science and industry informed regarding the technical programs, accomplishments, and activities of NBS.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Annual subscription: Domestic, $3; foreign, $4; single copy, 30 cents. The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through June 30, 1976.

NEW ENVIRONMENTAL RADIOACTIVE POLLUTANT STANDARDS ISSUED

While preparing mixed radionuclide standard reference materials Dr. Bert Coursey transfers an aliquot of the master radioactive solution to a sample bottle containing 450 ml of acid.



The new NBS mixed radionuclide standard reference materials will be of great help in providing better monitoring of the radioactive effluents of nuclear power generating stations. Radioactivity released to the air is monitored at the plant stack. Radiation released via the circulating water system is monitored at the water release point. Photo courtesy of the Atomic Energy Commission and the Connecticut Yankee Atomic Power Company.

Environmental monitoring of radioactivity associated with nuclear facilities across the United States should be more accurate because of a new Bureau program.

Three new radioactivity standards have already been issued by NBS as part of a major effort to help state health and safety laboratories and nuclear facilities improve their capabilities for measuring radioactive pollutants, which may find their way into the atmosphere or lakes and rivers.

NBS produces a host of national standards against which pollutants, materials, and other products may be measured. Standard Reference Materials (SRM's) are available to testing laboratories, industry, or other groups that need a high degree of accuracy and assurance of national uniformity. The new radiation standards were produced as part of the SRM program at the request and support of the U.S. Atomic Energy Commission to calibrate NaI(Tl) and Ge(Li) gamma-ray counting systems. They are known as Mixed Radionuclide Gamma-Ray Emission-Rate Standards SRM-4242, SRM-4243, and SRM-4244.

The SRM's are supplied in "standard geometry" flame-sealed, borosilicate glass bottles with solution volumes of 15 ml (SRM-4244), 50 ml (SRM-4243), and 450 ml (SRM-4242) and approximate total activities of 0.1 μCi, 1 μCi, and 0.5 μCi. Each SRM contains manganese-54, cobalt-57, cobalt-60, yttrium-88, cadmium-109, tin-113-indium-113m, and cesium-137-barium-137m in a solution of approximately 4N HCl.

These standards were prepared in the NBS Center for Radiation Research by J. M. R. Hutchinson, L. M. Cavallo, B. M. Coursey, and W. B. Mann. The individual radionuclides were calibrated for gamma-ray emission rates (known to ± 3 percent) by means of the NBS calibrated "$4\pi\gamma$"-ionization chamber, using literature values for nuclear decay scheme parameters. A standard mixture was then prepared from the calibrated solutions of individual radionuclides. The SRM's were prepared by quantitatively transferring an aliquot from this master solution, using a plastic weighing pycnometer, to a sample bottle containing a known weight of acid.

The three "standard geometries" were so chosen because they closely approximate bottles currently used in nuclear facilities. SRM-4242 is intended for use in the assay of radioactive waste water, while the objective of SRM-4243 is in the assay of primary coolant for light water reactors. Radioactive offgases can be assayed using the SRM-4244 as a mock gas standard. Empty reusable standard bottles with ground-glass caps may also be purchased with the standards for an additional charge.

Three older Standard Reference Materials are also available for use in the measurement of environmental tritium. These include two tritiated water standards, SRM-4926 and SRM-4927, and one tritiated toluene standard, SRM-4947. These standards have approximate beta-particle disintegration rates of 9×10^3, 9×10^5, and 3×10^5 $s^{-1}g^{-1}$.[1-3]

These standards may be purchased from the Office of Standard Reference Materials, Room B314, Chemistry Building, National Bureau of Standards, Washington, D.C. 20234. The cost of SRM-4242, SRM-4243, and SRM-4244 is $50 each. The empty bottles may be purchased with the standards for $10 each. The tritium standards SRM-4926 and SRM-4927 are $48 each and SRM-4947 is $46.

Technical information on these SRM's may be obtained from the Radioactivity Section, Room C114, Radiation Physics Building, National Bureau of Standards, Washington, D.C. 20234.

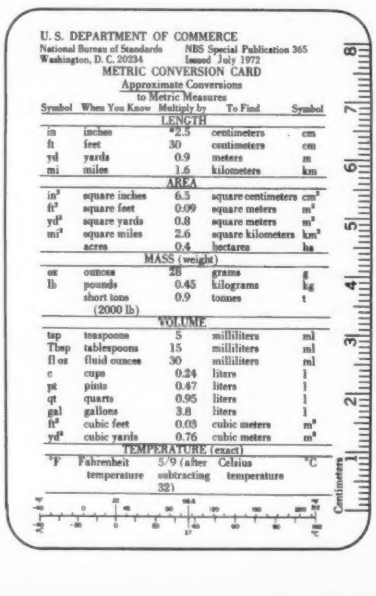
[1] Mann, W. B., The calibration of the National Bureau of Standards tritium standards by microcalorimetry and gas counting, Proc. of the Tritium Symposium, Las Vegas, Nev., Aug. 30-Sept. 2, 1971.

[2] Mann, W. B., Medlock, R. W., and Yura, O., A recalibration of the National Bureau of Standards tritiated water standards by gas counting, Int. J. Appl. Rad. and Isotopes **15,** 351-361 (1964).

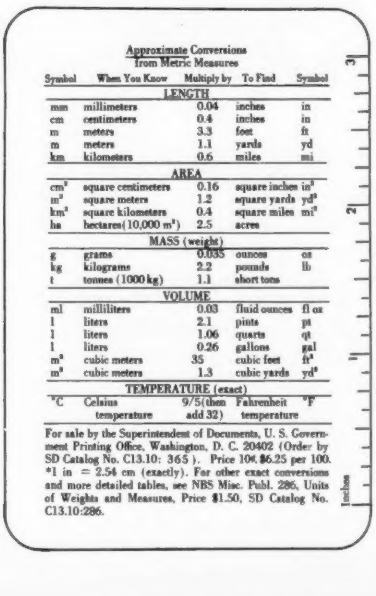
[3] Garfinkel, S. B., Mann, W. B., Medlock, R. W., and Yura, O., The calibration of the National Bureau of Standards tritiated-toluene standard of radioactivity, Int. J. Appl. Rad. and Isotopes **16,** 27-33 (1965).

Metric Conversion Card

The use of the metric system of measurement is increasing in the United States. As a result many persons frequently need to convert from customary to metric units and vice versa. The Bureau has prepared a plastic metric conversion pocket card which contains the minimum data needed for such conversions. One side gives the factors for converting from customary to metric units of length, area, volume, mass (weight), and temperature. The other side gives the corresponding conversion factors for going from metric to customary. The most widely used units are included and are accompanied by their accepted symbols. In addition, there is a centimeter scale along one edge of the card, an inch scale along another edge, and a direct-readout scale for converting from Fahrenheit to Celsius (Centigrade) temperatures and vice versa. All numbers are given to two-figure accuracy, sufficient for everyday practical needs. The card is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 or local U.S. Department of Commerce Field Offices for 10 cents each, or $6.25 per 100. Use SD Catalog No. C13.10:365 when ordering.


U. S. DEPARTMENT OF COMMERCE
National Bureau of Standards — NBS Special Publication 365
Washington, D. C. 20234 — Issued July 1972
METRIC CONVERSION CARD
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C


Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402 (Order by SD Catalog No. C13.10: 365). Price 10¢. $6.25 per 100. *1 in = 2.54 cm (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $1.50, SD Catalog No. C13.10:286.

ATOMIC CLOCKS: FIRST CLASS INTERNATIONAL TRAVELERS

What do you do if the passenger in the airplane seat next to you is a black box and is ticking? Chances are you should ask it the time; it is probably an atomic clock.

Atomic clocks use the vibrations of atoms as their "pendulum." Since the atomic vibration rate is very constant and relatively unaffected by outside influences, atomic time is incredibly accurate. It is about 100,000 times more accurate than the rotation of the earth as a timekeeping standard.

Atomic clocks get around a lot these days, what with synchronizing our spacecraft tracking stations and linking the time scales of large radio telescopes for studies of stellar radio emissions.

For many of these jobs, sophisticated atomic clocks are the only instruments with sufficient timing accuracy. Other methods have too much room for error.

Sometimes, however, it becomes necessary for the Bureau to know the difference between the American atomic time scale and the international atomic time scale maintained in Paris for this purpose. They buy a seat on a transatlantic jet and send a portable atomic clock on the trip, accompanied by a physicist to carry out the measurements and insure careful handling of the continuously running clock.

These comparisons are made every year or so to measure the difference between the NBS time and frequency standard and the time and frequency standard of the International Bureau of Time (BIH). Comparisons are necessary because the U.S. UTC (Universal Time Coordinated) scales, by international agreement, must be related accurately to the UTC (BIH) scale.

The most recent comparison, in September 1971, verified that the UTC (NBS) scale differed from the UTC (BIH) scale by less than 150 microseconds (millionths of a second). International agreement permits up to 1,000 microseconds difference. Even this small difference was virtually eliminated on January 1, 1972 when most UTC scales were adjusted slightly. The present difference is estimated to be less than 3 microseconds.

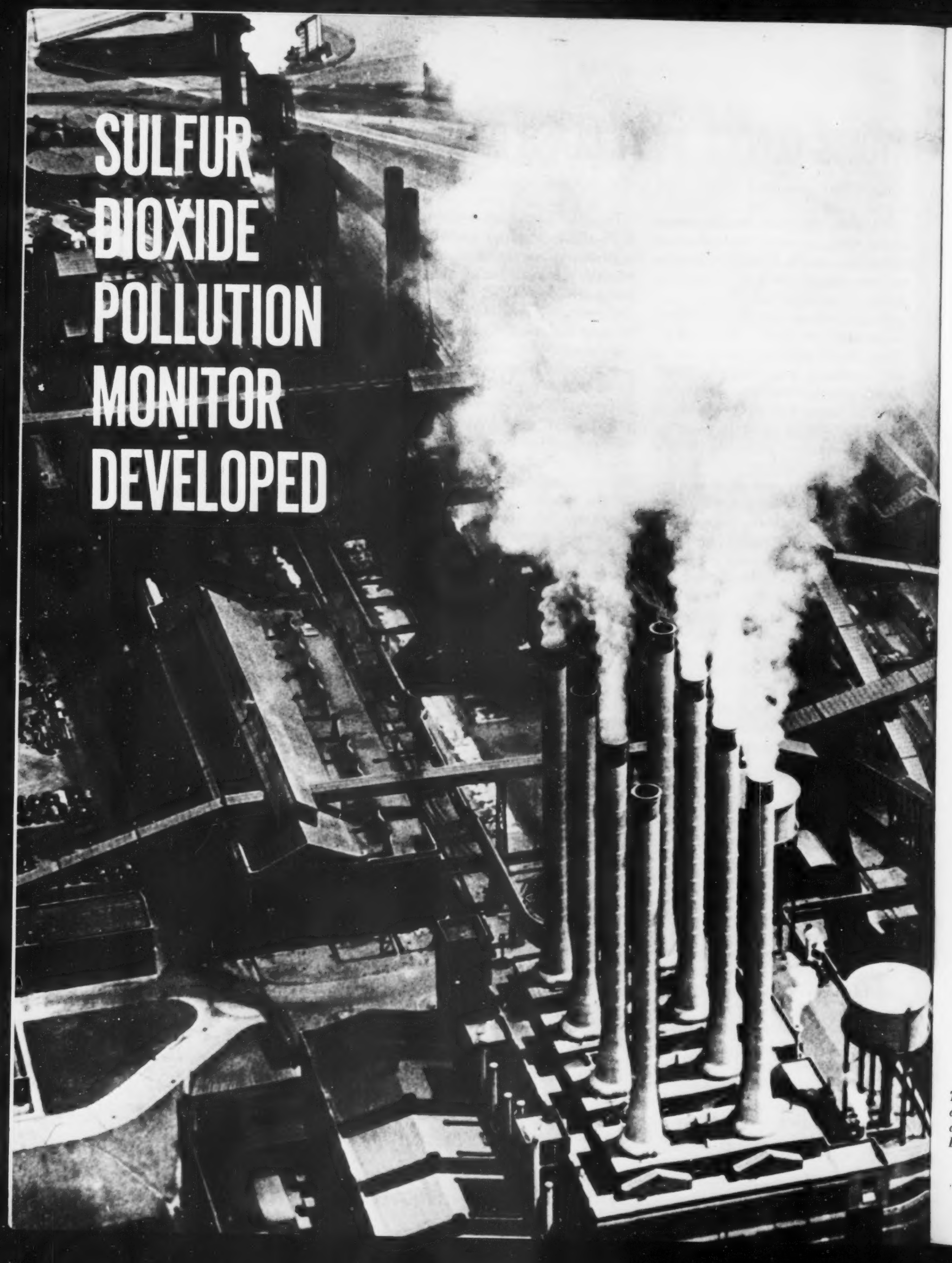
The BIH in Paris, France, is charged with generating an International Atomic Time scale (IAT) from the various time scales maintained in the participating countries. It maintains this scale as an international reference for comparison with all other scales, and as a base for generating the UTC (BIH) scale. All participating countries must then maintain their own UTC scales within 1/1000 of a second of UTC (BIH). Why must such a close tolerance be maintained? Primarily to avoid international ambiguities when specifying the exact time that events occur, especially scientific or astronomical events, and to permit international synchronization of clocks. If nations generate their own independent time scales with no provision for coordination, these scales will tend to diverge over the years, until, conceivably, 8 o'clock in the United States would coincide with half past 8 in Canada. Time scales diverge because clocks are not perfect, even atomic clocks. They all run at slightly different rates, and only by periodically resetting them can we maintain close agreement.

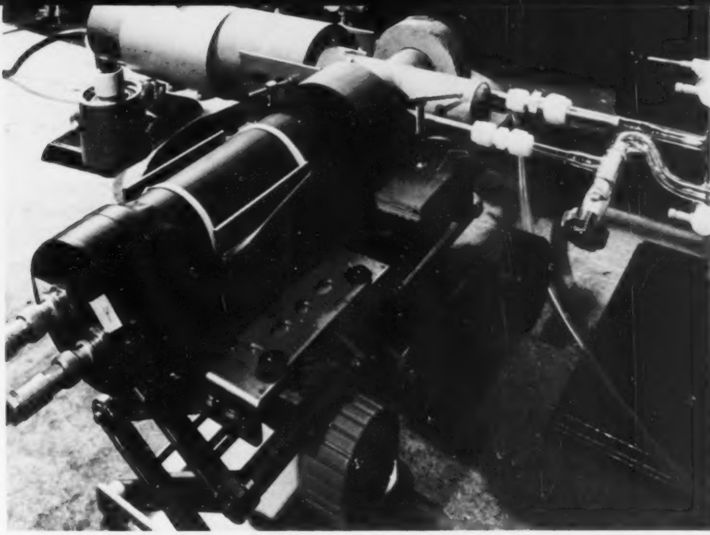
The UTC (BIH) scale, the standard of comparison for all the others, is controlled by reference to the BIH International Atomic Time scale (IAT). The IAT scale is a "paper" scale constructed by taking a weighted average of the atomic time scales of the participating countries. Seven laboratories, in the United States, England, Canada, France, Germany, and Switzerland, generate atomic time scales which are weighted and then used to generate the BIH IAT scale. UTC (BIH) is then adjusted to be an integral number of seconds different from IAT. (Currently, UTC (BIH) is 10 seconds later than IAT.)

Methods of comparing the various national scales and the BIH scale depend on the accuracy needed. Routine comparisons often employ radio transmissions such as LORAN-C. These transmissions are usually in the low to very-low frequency range to avoid some of the propagation errors that afflict high-frequency waves. More accurate comparisons require carrying portable atomic clocks from one laboratory to another. For instance, NBS can note the difference between a portable clock and the UTC (NBS) scale as maintained by the Time and Frequency Division in Boulder, Colo. Then the clock is put on an airplane (it occupies a seat in the first class section, where it can be plugged into the aircraft's power system) and flown to Paris. There, its reading is compared to the UTC (BIH) scale and the difference noted. Subtracting one difference from the other yields the difference between UTC (NBS) and UTC (BIH), and by calculation, the difference between NBS atomic time and BIH atomic time. Thus, the relations between the NBS scales and the BIH scales are established, and adjustments can be made to the UTC (NBS) scale, if necessary.

So, the next time you notice a ticking instrument strapped into the airliner seat next to you, and plugged into the wall, don't panic. Just ask it if the plane is on time. It will know.

SULFUR DIOXIDE POLLUTION MONITOR DEVELOPED





Laboratory model of a potential SO_2 stack gas monitor. Light from the cadmium lamp at left causes fluorescence of SO_2 in the 4-armed cell; the fluorescence is detected by the photomultiplier at the center foreground.

■ A sulfur dioxide pollution monitoring device,[1] in which several manufacturers have already shown an interest, has been developed at the Bureau.

The detector, based on the measurement of the fluorescence of SO_2 in air, is rapid, continuous, nearly specific to SO_2, and linear in response up to 1,600 parts per million.

The most obvious application of the new device is in the monitoring of smokestack gases. A recent California law limits the SO_2 concentration in stack gases to 500 ppm, and similar laws are being considered by other states. No present instrumentation measures such concentrations with high reliability.

About 80 million tons of SO_2 are released into the atomsphere each year, mainly through the burning of sulfur-bearing coal and oil, and through such industrial processes as oil and metal refining. Concentrations as low as a few parts per million can cause breathing difficulty, kill plants, leach limestone, and degrade paper and leather.

The monitor has potential use in determining the concentration of sulfur dioxide in stack gases. (Photo courtesy of the Environmental Protection Agency.)

The lower limit of detection of the monitor in its present form is 20 parts per billion, and a special light source is being developed that should make it possible to reach even lower levels.

Ozone, H_2S, NO_2, CO, CO_2, and H_2 do not interfere with SO_2 detection in the monitor, while large concentrations of CS_2 (500 times the SO_2 concentration), NO (500 times), and C_2H_4 (4,000 times) do interfere. Water vapor decreases the SO_2 signal—at room temperature, a relative humidity of 100 percent reduces the SO_2 signal by 25 percent—and a correction must be applied according to the concentration of water vapor in the air.

The fluorescence of SO_2 is produced in the cell attached to the detector by radiation from either a zinc or cadmium vapor lamp operating on alternating current. Before entering the fluorescence cell the light passes through a 10 cm chlorine filter that transmits more than 90 percent of the exciting zinc (213.8 nm) or cadmium (228.8 nm) line but absorbs almost completely source emission lines from 270 to 390 nm. (This is necessary because the fluorescence from SO_2 covers the region from 240 to 420 nm.) The light is then focussed at the center of the fluorescence cell, and the SO_2 fluorescence is detected by a photomultiplier and displayed on a strip chart. A glass filter between the fluorescence cell and photomultiplier rejects those source emission lines passed by the chlorine cell.

The response of the detector up to 10 ppm was calibrated with SO_2 permeation tubes, available from NBS under the Standard Reference Material program,[2] using air flow rates from 0.3 to 3 l/min. Above 10 ppm the device was calibrated with static air-SO_2 mixtures.

The monitor was developed by Hideo Okabe and Joseph Ball of the NBS Physical Chemistry Division, and Paul Splitstone, a guest worker at NBS from Alma (Michigan) College. The Project was partially funded by the NBS Measures for Air Quality Program. Dr. Okabe has applied for a patent, which, when granted, will be available for licensing to interested manufacturers.

[1] Okabe, H., Splitstone, P., and Ball, J., Ambient and source SO_2 detector based on a fluorescence method, paper 72-14, presented at the Air Pollution Control Association Meeting, Miami Beach, Fla., June 20, 1972.

[2] Information on SO_2 permeation tubes and on all of the Standard Reference Materials available from NBS may be obtained from the Office of Standard Reference Materials, Room B314 Chemistry Building, National Bureau of Standards, Washington, D.C. 20234.

TOWARDS INTERNATIONAL STANDARDIZATION

Olle Sturen, Secretary General of the International Organization for Standardization (ISO), spoke at the NBS Colloquium on June 9, 1972. Mr. Sturen became Secretary General in January 1969 following a most successful career as Secretary of the Swedish Standards Commission (Sveriges Standardiserings Komission). Under his leadership, ISO has become a much more effective international standards activity capable of meeting the standardization, harmonization, and certification challenges of the 1970's.

Pending legislation on international standards, the International Voluntary Standards Cooperation Act of 1972, and the Bureau's heavy involvement in international standards programs make his speech, a condensed version of which follows, a timely subject.

ISO is the international specialized agency for standardization and it comprises today the national standards bodies of 69 countries. The work of ISO is aimed at worldwide agreement on *international standards* for the sake of the expansion of trade, the improvement of quality, the increase of productivity, and the lowering of prices.

The initiative to form ISO was taken in 1946 by the United Nations Standards Coordinating Committee—the war-time organization consisting of the national standards bodies of 18 allied countries. ISO began to function on an official basis on February 23, 1947. Thus, the current year is the Silver Jubilee Year of ISO.

When ISO was created there were already a total of some 150,000 national standards in existence, many of them conflicting. Not only did larger countries like the United States, the United Kingdom, and Germany have their own sets of national standards, but a number of smaller countries also had published numerous national standards.

Consequently, efforts within ISO were concentrated in an attempt to harmonize the national standards of the member countries. In those post-war years, however, there was only limited interest in international standardization; the creation of ISO had not changed the overall situation. The national standards institutes were still giving first priority to their national work. International standardization was considered as a useful but hardly an indispensable activity.

It was not until the midsixties that international standardization really began to break through. The rapid technological development and the increase in international commerce uncovered the need for more international standards. Having removed a great many of the tariff barriers to trade, the world discovered rather suddenly the remaining barriers, not the least of which were technical.

Linked to the discovery of the technical barriers to trade and the increasing interest in international standardization of the past 10 years are such factors as:

- The development of multinational companies which found their commercial activities hampered by conflicting national standards; and
- The recognition by other international organizations of the need for rules in technical questions.

But there were also other reasons behind the change:

- The creation of standards institutions in a great many developing countries which realized the need for a sound international basis for their national work; and
- The widening scope of ISO, which engaged more and more people from different interest groups, including the consumer movement.

In other words, by the midsixties there had developed a *demand* for international standards—not only a desire. The climate was right for ISO's growth. The result: While only a hundred ISO Recommendations were published in the fifties, some 1,400 international standards agreements were reached in the following decade.

Today there are nearly 2,000 ISO Recommendations, half of which were published in the last 3 years. A further 2,000 drafts and proposals are in the pipeline, and the total number of ISO agreements is con-

fidently expected to double within the next 4 or 5 years.

There are different opinions as to how many international standards we need. In the main, however, informed persons agree that in a highly industrialized society the total need of national *and* international standards is of the order of 15,000, or maximum 20,000.

Then comes the question of how much of the total need should be met by *international* standards. Here opinions differ widely. Therefore, ISO has started a study with a view to determining the total request for international standards. Until we have the result of this study we can only guess. Without going deeper into this subject, I think it is fairly safe to predict that ISO has up till now published perhaps some 20 percent of the international standards needed with another 20 percent in the pipeline.

The technical work of ISO is at present carried out by some 1,200 technical bodies (technical committees, subcommittees, and working groups). More than 50 percent of these bodies have been created in the last 5 years. I do not foresee, however, a continuation of this growth rate in the number of technical bodies. ISO probably will not operate at the same time more than 1,000 to 1,500 technical bodies, but within this number we shall switch our emphasis from one subject to another by creating, putting aside, or dissolving committees. Already, more than 50,000 experts are engaged in the ISO work through their ISO member bodies.

The ISO technical work is highly decentralized with the secretariats of the technical bodies distributed among the ISO member bodies and a Central Secretariat in Geneva for the planning and coordination of the activity.

Geographically, the need for international standardization first became apparent in Western Europe and for many years other regions played only a minor role in the ISO work. As late as the end of the fifties, Western European countries held practically all the ISO technical secretariats, and almost all ISO meetings were held in Europe.

In recent years, however, more and more countries outside Europe have become active in the ISO work. With the entry of these countries as *active* ISO members, ISO is developing into a truly international organization. One significant sign of this trend is the composition of the 1972 ISO Council, which is charged with the operation and administration of the Organization between meetings of the General Assembly. France, Germany, Italy, Norway, and the United Kingdom are members of the Council, but a healthy balance of interest and geographical location is provided by the presence of such member countries as Australia, Brazil, Canada, India, Iran, Japan, Romania, the United States, and the U.S.S.R.

Another sign of the trend towards internationalism is that though Western European countries still hold a large proportion of the technical secretariats, the distribution of them has now become more widespread as countries such as the United States, the U.S.S.R., India, Japan, and Australia have assumed greater responsibilities. Today, ISO technical secretariats are located in 28 countries.

As a result, the emphasis within ISO is now shifting towards the development of international agreement in the first place in preference to the traditional practice of endeavoring to reconcile differences among national standards.

One sign of this change in attitude is that our results are now published as ISO International Standards instead of ISO Recommendations, the form used up till the end of last year. While a Recommendation was what the word stands for—a recommendation to the ISO member bodies to use the

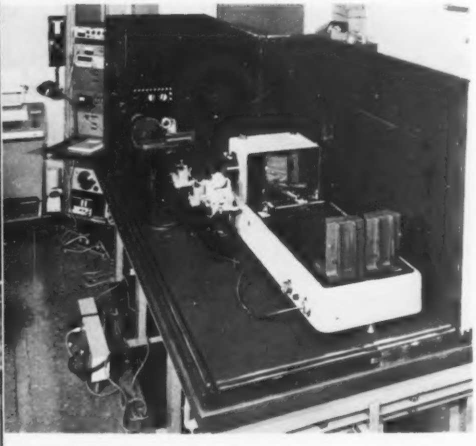
The initiative to form ISO was taken in 1946 by the United Nations Standards Coordinating Committee. (Photo of UN building by H. M. Lambert.)

content as the basis for a national standard—the ISO International Standard is a document that can, and will be, used as a standard in its own right—a competitor, in some cases, to parallel national standards but, hopefully, more often a real substitute for the different national standards.

A number of Western European countries have already decided to adopt ISO International Standards as their national standards whenever possible. The European standards to be issued by CEN (the Standards Committee comprising the Western European Standards Institutes) will also be merely endorsement of ISO standards whenever such are available. Then the Commission in Brussels for the European Common Market intends to refer to the CEN European Standards in the technical regulations

Continued on page 250

HIGHLY ACCURATE SPECTROPHOTOMETER DEVELOPED



Monochromator (right), sample-holding area, and averaging sphere of the spectrophotometer.

A spectrophotometer that has achieved new levels of precision and accuracy, and is expected to have a significant impact on spectrophotometry both as a model for improved instruments and through the improvement of standard calibration filters, has been designed and constructed.[1]

The spectrophotometer will be used at the Bureau to help realize the candela—the basic unit of luminous intensity or brightness. The design principles developed in this work also should ultimately result in more accurate measurements in clinical laboratories, and the numerous industries which rely on color measurements such as paint, textile, appliance, and petroleum producers.

The instrument, developed by K. D. Mielenz and K. L. Eckerle,* has a precision of approximately 4×10^{-5} transmittance units. Instrumental accuracy is estimated to be within approximately 10^{-4} transmittance units.

The spectrophotometer features off-axis mirror optics and placement of the sample in a collimated and linearly polarized beam. The off-axis mirror design rather than use of lens optics significantly reduces beam displacement, interreflectance, and obliquity effects.[2] In addition, detector nonlinearity is taken into account using a new double-aperture testing procedure for increased precision.[3] Experimental work with the apparatus indicates that its design constitutes the optimal beam geometry for high-accuracy spectrophotometry.

The monochromator employed in the instrument is an f/8.7 Czerny-Turner system with 1-m off-axis parabolic mirrors and a 1,200-lines/mm plane grating blazed for 500 nm. The entrance and exit "slits" are interchangeable circular apertures with diameters ranging between 0.25 and 1 mm, so that the exit aperture approximates a point source having a spectral band pass between 0.2 and 0.8 nm when the grating is used in the first order. The light from the monochromator is collimated by one 195-mm off-axis parabolic mirror, and focused into the detector by another. These two mirrors are mounted at the ends of a 120-cm precision optical bench, the space between the mirrors constituting the sample compartment of the spectrophotometer.

The large sample space permits simulation of the beam geometries of other instruments for comparison studies by means of lenses placed in the collimated beam.

The light source is a current-stabilized tungsten-ribbon lamp, operating in the color-temperature range of 1,600 to 2,600 K. Except for a possible linear drift in time, the radiant-flux output of this source is constant to better than 0.02 percent for periods of up to 20 min. The flux into the monochromator is varied by altering the lamp current or rotating the first of two Glan-Thompson prisms. The second Glan-Thompson prism defines the state of polarization of the light. The source is focused on the entrance slit of the Ebert prism predisperser which precedes the grating monochromator.

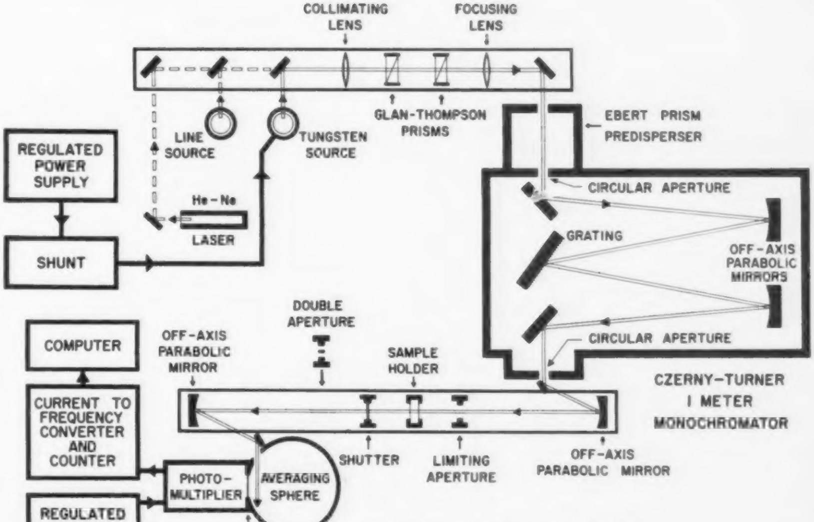
A low-power helium-neon laser was built into the system for alignment purposes, and spectral lamps are provided for calibration of the

wavelength scale to a 0.02-nm accuracy.

The detector is an end-on photomultiplier tube attached to a 15-cm averaging sphere with an estimated efficiency of 20 percent. The photomultiplier power supply is voltage-regulated to 0.001 percent, and the anode current is measured by a current-to-frequency converter. The photomultiplier was found to be shot-noise limited. The converter and its associated high-precision counter were found to be linear to better than 1 part in 10^4, and to have a full-scale repeatability within 2 parts in 10^5 with the counter integrating over a 10-s interval.

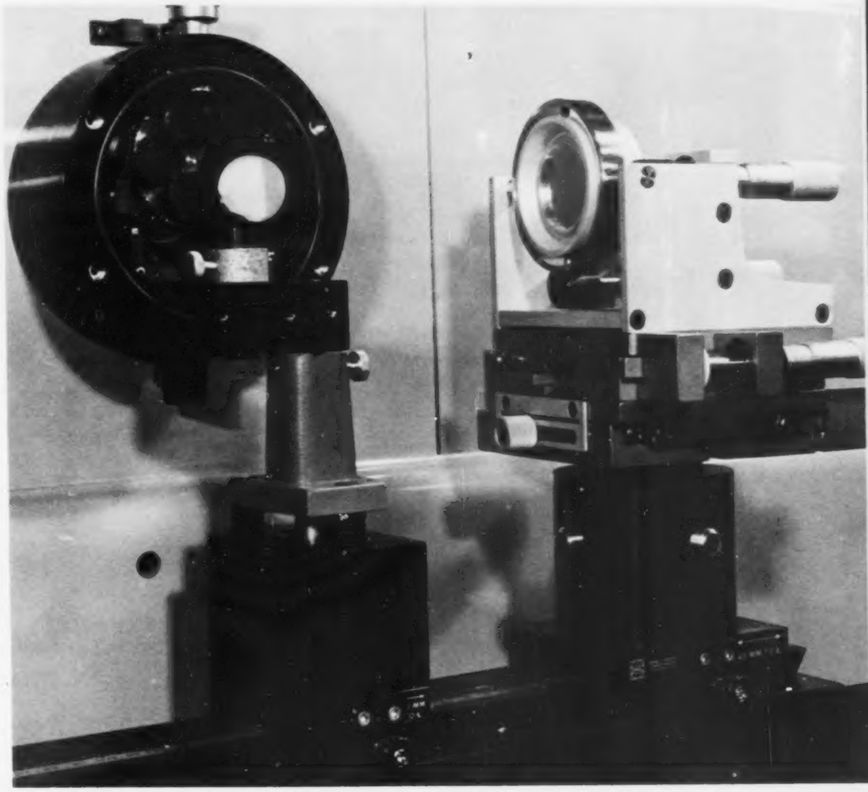
The counter signals are recorded automatically on punched paper tape by a data acquisition and control system, which is also used as a computer terminal to process the recorded data.

A series of tests was undertaken to determine the instrument's photometric precision. Standard deviation of a single measurement of transmittance is of the order of 10^{-4} transmittance units or less, provided that the signal current for the 100-percent point of the transmittance scale is chosen to be equal to or slightly greater than 10^{-7} A. As an indication of overall measurement precision, separate transmittance measurements of neutral-density-glass filters with nominal transmittances of 0.1, 0.2, and 0.3 were found to be repeatable to ± 0.00004.



Schematic diagram of the new spectrophotometer.

Closeup view of the off-axis parabolic mirrors (right) and circular apertures used in the spectrophotometer.



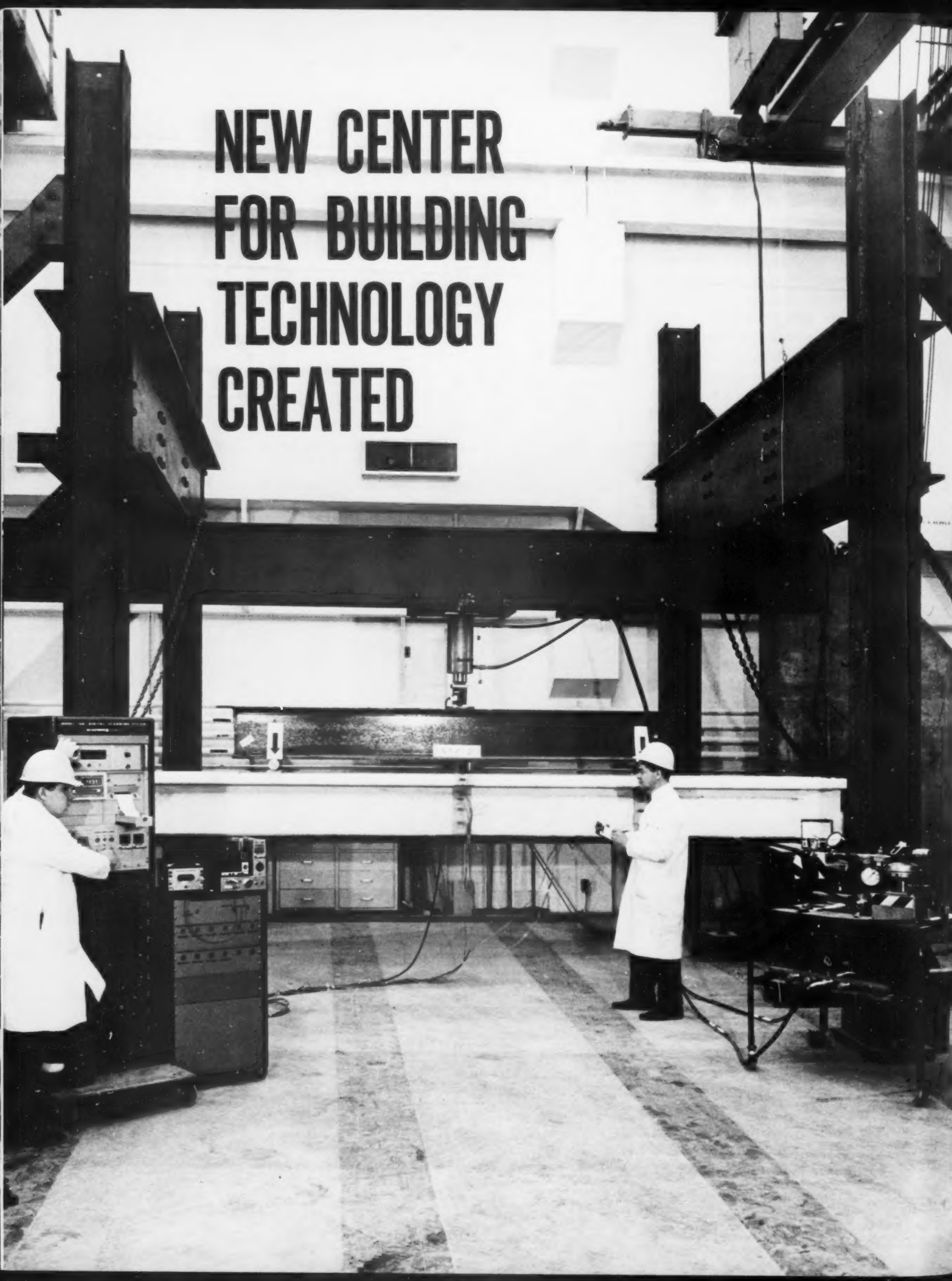
[1] Mielenz, K. D., and Eckerle, K. L., Design, Construction, and Testing of a New High Accuracy Spectrophotometer, Nat. Bur. Stand. (U.S.), Tech. Note 729, price 60 cents, SD Catalog No. C13.46:729 available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

[2] Mielenz, K. D., Physical parameters in high accuracy spectrophotometry, J. Res. Nat. Bur. Stand. (U.S.) (to be published).

[3] Mielenz, K. D., and Eckerle, K. L., Spectrophotometer linearity testing using the double-aperture method (to be published in Applied Optics, Oct. 1972).

*This work was initiated in the Optical Physics Division by R. P. Madden, J. Reader, and J. C. Schleter.

NEW CENTER FOR BUILDING TECHNOLOGY CREATED



■ A new Center for Building Technology has been created at the Bureau.

"The Center will expand the Department's role in providing an improved technological basis for better, safer houses, and other buildings for the American people," according to Dr. Lawrence M. Kushner, Acting Director of NBS.

The new Center will incorporate building research activities which have been ongoing at the Bureau since 1901. Recently, these activities have supported the Department of Housing and Urban Development with the testing of housing for Operation Breakthrough. Much of the evaluation of building materials and building models—even entire housing units—is carried on in the NBS environmental test chambers.

The Center, whose Director is Dr. James R. Wright, is staffed with a wide range of building specialists, from physical scientists expert in construction materials to social and behavioral scientists seeking a closer "fit" between buildings and their occupants.

Dr. Kushner said the Center will provide an effective means for "cooperating with the States, local government, the building industry, and the consuming public in achieving greater benefit from the Bureau's long experience in building science and technology." Stronger ties with the private sector and other governmental units are called for by the Commerce Department order establishing the new organizational unit.

The Center is also designed to provide greater operational efficiency. It is located within the NBS Institute for Applied Technology, as was its predecessor, the Building Research Division. It comprises an Office of Housing Technology; an Office of Federal Building Technology; an Office of Building Standards and Codes Services; a Building Environment Division; a Structures, Materials, and Life Safety Division; and a Technical Evaluation and Application Division.

The Center will have guidance from a new policy advisory committee. Members of the advisory committee will be knowledgeable in such areas as building materials manufacture, construction unions, general contracting, specialized contracting, the design professions, the home-building industry, building-related finance, and consumer interests.

An existing program of the National Academy of Sciences/National Academy of Engineering/National Research Council will continue to provide scientific and technological advice from private-sector experts.

Brief descriptions of each of the major operational units comprising the Center follow.

Structures, Materials, and Life Safety Division, W. C. Cullen, Acting Chief, deals with the physical materials that make up buildings. The work on structures involves the behavior of materials and components under load, support and stability characteristics of building elements and systems, the development of design strategies relating to all types of building loads, including wind, snow, and earthquake. The Division's materials work relates to the evaluation, test development, and measurement of long-term durability of simple and composite building materials. Its safety work is primarily directed toward fire and smoke hazards in buildings. (Fire activities in CBT are an integral part of the overall NBS Fire Research and Safety program.)

Building Environment Division, P. R. Achenbach, Chief, deals with the performance of the systems and equipment that control building environments, with the characterization of that environment, with the user's response to his environment, and with the development of criteria which describe environmental effectiveness. Present research areas involve building service systems, communications, acoustics, illumination, energy conservation in buildings, total energy systems, integrated utility systems, indoor air quality, and moisture and heat transfer phenomena.

A wall section instrumented with thermocouples being tested for flame-through and smoke generation while carrying a simulated load.

Technical Evaluation and Application Division, H. E. Thompson, Acting Chief, undertakes activities in architectural research and building economics, and is responsible for maintaining liaison with the building community. The Division develops performance requirements and criteria and deals with improvements in the design and construction process, building costs and benefits, social science studies, urban technology, and building research information services. It evaluates the technical, professional, and user experience to formulate the application of performance criteria for the design for buildings and their relation to the environment whether urban or rural.

Office of Building Standards and Codes Services, G. A. Rowland,

Thomas Reichard inspects a prototype plastic "honeycomb" proposed for use as core material in sandwich panels for walls, floors, and roof-ceiling systems.

McClure Godette is using an atomic absorption spectrophotometer to determine trace amounts of lead in paint pigments.

Chief, provides technical and administrative assistance to the States, local governments, and codes and standards organizations in the use of building regulatory provisions and practices. The Office coordinates and manages CBT's participation in the work of the standards committees. It serves as Secretariat to the National Conference of States on Building Codes and Standards.

Office of Housing Technology, Dr. E. O. Pfrang, Chief, manages housing research programs, coordinating the work of experts in diverse disciplines. It develops research requirements and, through cooperation with the housing industry and public agencies having housing responsibilities, ensures that its research undertakings are pertinent, that its technical findings are disseminated in a meaningful way, and that its recommendations are properly applied.

Office of Federal Building Technology, S. Kramer, Chief, is the central focus for CBT interaction with other Federal agencies concerned with buildings. The Office manages research projects undertaken at the request of other agencies, provides technical and informational assistance, seeks to develop agency support for projects of common interest, holds workshops for agency personnel, and formulates recommendations on the need for research approaches responsive to agency missions.

CORRECTIONS

The article on NBS and the Development of Computer Technology, appearing in the July 1972 *Technical News Bulletin*, contained three errors.

1. The title "Electronic Numerical Integrater and Automatic Computer (EINAC)" should have been "Electronic Numerical Integrator and Calculator."
2. The title "Eckert and Mauchley Electronic Control Co." should have been "Electronic Control Company (later the Eckert-Mauchly Computer Corporation)."
3. The name "Mauchley" should have been "Mauchly."

NBS HELPS GUIDE FOREIGN COMPUTER TECHNOLOGY

Technology can play an important role in reducing the disparities that exist between developing and developed countries. Computers are especially important, for they can serve as a tool in planning the development process itself as well as in applications where the developing is taking place.

In recognition of the potential impact of the computer on emerging nations, Ralph A. Simmons, CCST Staff Assistant for International Computer Technology, recently visited a number of developing countries to discuss the use of computer technology in the areas of social and economic development.

The trip—to Nigeria, Ethiopia, Uganda, and Kenya—was part of a joint AID/Commerce project to increase the effective use of computer technology in less well-developed nations. The project, which in the Department of Commerce is within the Office of the Assistant Secretary for Science and Technology, is the outgrowth of the importance placed by the President and the Secretary of Commerce upon the role of technology in the development process and in the strengthening of U.S. international trade.

The President has requested an effective U.S. foreign assistance program for the 1970's with emphasis on the concentration of our special capabilities in science and technology to help meet basic human needs. Effective use of computer technology can contribute to this goal and can be significant in our efforts to create an improved U.S. posture in international trade.

PROJECT GOALS AND TASKS

The goal of this project is to develop an organized framework within which can be considered specific issues related to the appropriate nature of computer activities at various levels of national development; for example, the establishment of the most appropriate balance for investments in hardware, software, and training; the relation of computer technology to employment and foreign exchange; the application of computer technology to development; the choice of centralized *vs.* decentralized systems. This framework is intended to include criteria to be considered by decision makers in the less developed countries and by those directing U.S. foreign aid and to present the significance of the criteria under stated conditions.

The first task is the survey and synthesis of information concerning computer technology and applications within selected less developed countries. The countries of Ethiopia, Nigeria, Uganda, Brazil, Colombia, Turkey, Korea, and Thailand have been chosen to receive detailed study.

The objective is not to support a financial or technical assistance program for any specific country but to develop guidance that will assist in the decision-making process and in planning related to national development and computer technology.

TRIP RESULTS

The information collected on Mr. Simmons' trip has conclusively supported the need for this project, for it has shown that even though conditions vary greatly among Nigeria, Ethiopia, and Uganda, certain patterns are common to all three. They all show, for example, diffusion of responsibility and inefficient use of critical manpower and equipment; education and training is a major requirement, with emphasis needed at the senior management level as well as the level of systems analysts and programmers. Although physical facilities are not what we are accustomed to in the United States, in general they do not present an insurmountable problem.

This investigation also revealed that computer applications are limited principally to business applications, statistics, and some engineering; and that the computer is not being used as a tool to assist in

Continued on page 249

NATIONAL STANDARD NSRDS REFERENCE DATA SYSTEM NEWS

The NSRDS was established to make critically evaluated data in the physical sciences available to science and technology on a national basis. The NSRDS is administered and coordinated by the NBS Office of Standard Reference Data.

CONSOLIDATED VOLUME OF TABLES OF MOLECULAR VIBRATIONAL FREQUENCIES

Establishing the assignment of molecular vibrational frequencies has fundamental importance in explaining various problems in physics and chemistry. The information concerning the force field and motion of atoms in a molecule can be most directly derived from its vibrational frequencies. If all the vibrational frequencies of a molecule are known, as well as the molecular structure, thermodynamic quantities can be easily computed on the ideal gas model. Thus, the need for a tabulation of evaluated reference data on molecular vibrational frequencies has often been felt by many investigators. In 1964 a project for producing such tables was initiated at the University of Tokyo in cooperation with the National Standard Reference Data System of the National Bureau of Standards. The evaluated data resulting from this project have been published as Tables of Molecular Vibrational Frequencies, Part 1 (NSRDS-NBS-6), Part 2 (NSRDS-NBS-11), and Part 3 (NSRDS-NBS-17). NSRDS-NBS-39, *Tables of Molecular Vibrational Frequencies, Consolidated Volume* by T. Shimanouchi[1] (SD Catalog No. C13.48:39, $3) consists of the contents of these three publications with extensive revision in the light of new experimental data, plus tables for 52 additional molecules for a total of 223 molecules.

Selected values of the fundamental vibrational frequencies are given for each molecule, together with observed infrared and Raman spectral data and citations to the original literature. The selection of vibrational fundamentals has been based on careful studies of the spectral data and comprehensive normal-coordinate analyses. An estimate of the accuracy of the selected values is included. The tables provide a convenient source of information for those who require vibrational energy levels and related properties in molecular spectroscopy, thermodynamics, analytical chemistry, and other fields of physics and chemistry.

CONFERENCE ON CRITICAL EVALUATION OF CHEMICAL AND PHYSICAL STRUCTURAL INFORMATION

A conference will be held June 24-29, 1973, at Dartmouth College, Hanover, N.H., to discuss problems in the critical evaluation of structural information derived by diverse experimental and theoretical methods. The objective is to enable scientists utilizing structural information derived from fields outside their own specializations (theoretical calculations, crystallographic diffraction, optical spectroscopy, microwave spectroscopy, nmr and esr spectroscopy, Mössbauer spectroscopy, electron diffraction, electric polarizability, etc.) to evaluate such information critically. Sessions will be devoted to statistical analysis of experimental data, methods of determining molecular symmetry, structural parameters describing molecular geometry, vibrational force fields and parameters, large-amplitude motions (such

as internal rotations, inversions, and ring puckering), structural parameters related to electronic charge distribution, and correlation of experimental with theoretical methods of determining structural information.

The conference is sponsored by the Committee on Chemical Crystallography of the National Academy of Sciences—National Research Council, with support from the National Science Foundation. Cochairmen of the organizing committee are Carroll K. Johnson and David R. Lide, Jr. Attendance will be limited to 100-150 participants, by invitation, and proceedings will be published. To receive further information and application forms, available by October 1, 1972, please write to M. A. Paul, Executive Secretary, NRC Division of Chemistry and Chemical Technology, National Academy of Sciences, 2101 Constitution Avenue NW., Washington, D.C. 20418.

SYMPOSIUM ON APPLICATIONS OF NUCLEAR DATA IN SCIENCE AND TECHNOLOGY

The International Atomic Energy Agency will convene a Symposium on Applications of Nuclear Data in Science and Technology. At the invitation of the Government of France, the Symposium will be held in Paris, March 12-16, 1973. The aim of this Symposium is to serve as a forum for intercommunication between users, compilers, and evaluators of nuclear (including neutron) data for applications in science and technology. A list of proposed topics include: nuclear data for fission reactors, nuclear data for activation analysis, status of compilations and evaluation of nuclear structure and reaction data, nuclear data in applications of radioisotopes, nuclear data for safeguards, nuclear data for thermonuclear fission reactors, nuclear data for space and accelerator shielding, nuclear data for astrophysics, and a summary panel. The nomination of a participant will be accepted only if it is presented by the government of a member state of the International Atomic Energy Agency or by an international organization invited to participate. Proceedings of the meeting are planned to be published within 6 months after the meeting.

CLASS II SPECTRA

Specifications for evaluating infrared spectra were formulated by the Coblentz Society Board of Managers in 1966,* under the sponsorship of the Office of Standard Reference Data. The key to the evaluation was a system of classifying spectra according to their purpose and quality. A class I spectrum was defined as a spectrum completely independent of the spectrometer—in other words, a physical constant of the material. No class I spectra have yet been produced, but Fourier transform spectrometers may make such spectra a real possibility within the next few years.

A class II infrared spectrum, or research quality analytical spectrum, was defined as a spectrum of a pure material, produced on a good grating spectrometer, using good technique, and run under optimum conditions. Class III spectra, or approved analytical reference spectra, are those produced on defined substances, again using good sampling techniques, with a high-quality NaCl prism spectrometer or a grating spectrometer not meeting class II standards.

In 1967, the Coblentz Society and the American Society for Testing Materials jointly initiated a pilot project to generate a limited number of research quality (class II) infrared reference spectra. Six infrared laboratories participated, each producing 25 spectra from samples selected from a group of 57 authentically pure chemical compounds. Three of the compounds were run by all laboratories in order to provide a basis for comparison and evaluation. Results of this project were reported in an article, "Happiness is a Class II Spectrum," by A. Lee Smith and W. J. Potts in Vol. 26, No. 2 (1972) issue of *Applied Spectroscopy.* Points covered include a discussion of why class II spectra are important to the future of infrared spectroscopy, some of the difficulties encountered by the participating laboratories and ways of overcoming these difficulties, and a critical comparison of spectra from the same compounds produced on different spectrometers and under different sampling conditions.

*"Coblentz Society Specifications for Evaluation of Infrared Reference Spectra," by Board of Managers, Coblentz Society, Analytical Chemistry **38**, No. 9 (Aug. 1966). Reprint available from the Office of Standard Reference Data, National Bureau of Standards, Washington, D.C. 20234.

BERKELEY PARTICLE CENTER PUBLISHES TWO NSRDS COMPILATIONS

The Berkeley Particle Data Center, supported by the U.S. Atomic Energy Commission, the National Science Foundation, and the Office of Standard Reference Data, with close collaboration with the European Nuclear Center (CERN), has recently published two critically evaluated data compilations. NSRDS-LBL-55, *$K^0_L N$ Interactions—A Compilation*, March 1972, by Fumiyo Uchiyama and James S. Loss is a compilation of 13 papers reporting $K^0_L N$ interactions. Cross sections, differential cross sections, angular distributions, forward differential cross sections, and the phase for regeneration are summarized. A brief synopsis is given for seven experiments in progress at the time of this compilation. The cutoff date for this report was January 1972.

NSRDS-LBL-100, *Review of Particle Properties*, April 1972, by the Particle Data Group is reprinted from Physics Letters, April 1972,

Continued on page 249

OPTICAL RADIATION NEWS

Optical Radiation News (ORN) is intended to serve as a means of communication among workers in industry, universities, and government agencies involved in radiometry and photometry. ORN will focus on developments in the laboratory, in the published literature, and at the council table, which are of interest to its readers.

PHOTOMETRIC INSTRUMENTATION AND RESEARCH

NBS Technical Note 594-2, Photometric Instrumentation and Research, is now available.[1] This publication, the second in a series on Optical Radiation Measurements,[2] was authored by E. F. Zalewski, A. R. Schaefer, K. Mohan, and D. A. McSparron.

This Technical Note contains descriptions of some of the instrumentation developed and experiments undertaken during the initial phase of the new NBS photometric research program. The electronic instrumentation that is described includes two versions of a direct current-to-voltage converter for amplifying the output of silicon PIN photodiodes and selenium barrier layer photocells. These circuits were developed by the NBS Electronic Instrumentation Section and are based on commercially available integrated circuit operational amplifiers. Also included is a discussion of the operation of stable dc lamp power supplies in both voltage and current feedback-controlled modes. The mechanical instrumentation that is described includes the optical benches, baffles and enclosures, three different lamp orientation mounts, and a kinematically designed medium bipost lamp socket being used in photometric research. The experiments that are described include measurements of the drift in the geometrically total luminous flux output during more than one hundred hours of operation of a group of similar lamps set at both a fixed voltage and a fixed current; the orientational dependence of the luminous intensity output of three different lamp types; and the relighting reproducibility of the intensity of a group of similar lamps.

The instrumentation described is now in use in several of the present photometric research projects. In addition, the experimental results discussed in this Technical Note have been of use in the planning of further research in photometry.

"DICTIONARY" FOR RADIOMETRY

A one-year effort to prepare a Reference Book on Radiometric Nomenclature is under way at the Naval Weapons Center, China Lake, Calif. Fred E. Nicodemus of the Michelson Laboratory is starting with the material on radiometry (including photometry) that he prepared for a proposed Military Standard on Infrared Terms and Definitions. That material will be expanded into a more general treatment no longer emphasizing just the infrared portion of the spectrum or military applications. The complete text is to be ready by June 1973 for final editing and publication as a hard-cover book. This reference book will facilitate translation among the many varied systems of nomenclature now in use in different areas of application (photometry and illumination engineering, astronomy and astrophysics, meteorology, heat transfer (mechanical) engineering, military electro-optics, etc.). It should serve as the starting point for various scientific and technical societies to try to arrive at a more nearly uniform nomenclature (concepts, terms, symbols, units) for use by all concerned.

An essential feature of the proposed military standard was to make a definite choice of recommended nomenclature. For reasons set forth in some detail in his introduction, Mr. Nicodemus chose the "phluometry" scheme of nomenclature proposed by R. Clark Jones [J. Opt. Soc. Amer., Vol. 53, No. 11, Nov. 1963, pp. 1314-1315]. At the April 1972 Meeting of the Technical Group on Radiometry and Photometry of the Optical Society of America in New York this scheme proved to be quite controversial.

The new Reference Book, on the other hand, is not constrained to recommend a particular scheme of nomenclature, nor will it be backed by legal authority, such as the Department of Defense in the case of the Military Standard. Consequently, Mr. Nicodemus is studying the question of whether and to what extent such recommendations and possible alternatives should be included. In any case, the Reference Book will emphasize much more the factual description of the various nomenclature practices in various areas of application

for radiometry, particularly the exact definitions and interrelationships between them to facilitate translating from one to another. For example, the term "magnitude" or "stellar magnitude" used by astronomers has been identified in the proposed military standard test with the corresponding terms "irradiance" and "illuminance" ("incidance") [and "radiant intensity" or "luminous intensity" in the case of absolute magnitudes].

Mr. Nicodemus invites inquiries and suggestions from all concerned individuals to help him in trying to produce a Reference Book that is as useful and effective as possible. In particular, he would like to be informed of material concerning unusual variants and possibly unfamiliar areas where radiometry is employed with different nomenclatures. He may be reached at Naval Weapons Center (Code 4056), China Lake, Calif. 93555, telephone (714) 939-2548/-2549.

PRICES FOR NEW BASIC AND GAGE CALIBRATIONS

Prices for the new basic and gage calibrations announced in this column in June 1972 are summarized in the table. More information on the calibrations may be obtained in Measurement Users Bulletin No. 4, a supplement to NBS Special Publication 250, 1970 edition.

Physical parameter	Item No.	Wavelength range or magnitude	Cost (July 1, 1972)
Special radiance	(1)*	225–800 nm	$1,350
	(2)*	650–2400 nm	1,350
	(3)*	225–2400 nm	1,775
	(4)	1.5–14 μm	{1,800 / 2,600
Spectral radiance	(5)*	250–800 nm	1,000
	(6)*	800–1600 nm	1,000
	(7)*	250–1600 nm	1,200
Irradiance	(8)	130 mw/cm²	550
	(9)*	30 mw/cm²	570
	(10)*	3 mw/cm²	430
	(11)	0.6 mw/cm²	430
Luminous intensity	(12)*–(14)*	90–1400 candelas	{240 / 330
Luminous flux	(15)–(19)	270–10,000 lumens	170
Spectral irradiance	(20)*	800–2400 nm	600
Irradiance (253.7 nm Hg line)	(21)	0.5–30 μwatts/cm²	500
Color temperature	(22)*	2000–3000 K	{156 / 107 / 498
Luminous flux (geometrically total).	(23)*	6 lumens	125 (set of 3)
Luminous directional transmittance.	(24)*	0.15 cd/m² per incident lux.	100
Luminous transmittance and luminous directional transmittance.	(25)*	0.25 and 0.035 cd/m² converts 2856 K to 4700 K	300

*Source normally provided by NBS; others by customer.

CORM ACTION

The Council for Optical Radiation Measurement (CORM) is now completing the first phase of its program. Its two meetings thus far have resulted in the report "Pressing Problems and Projected National Needs in Optical Radiation Measurement: A Consensus of Services Desired of NBS." Copies of the report may be obtained from the editor, E.S. Steeb, General Electric Co., Nela Park, E. Cleveland, Ohio 44124.

After extensive discussion of all testimony from these meetings, this report was compiled by the Council's executive body, Technical Committee 1.2 on Photometry and Radiometry of the U.S. National Committee of the Commission Internationale de l'Eclairage. All participants in the Council were asked to review the report before submittal to NBS. The report therefore constitutes a consensus of the entire industry represented in CORM.

The second phase of the CORM program will begin at its third meeting to be held in San Francisco October 16-17 in conjunction with the Optical Society of America meeting there October 18-20. This will involve discussion of two major issues: the first is the establishment of priorities among the various elements included in the report. The second is the establishment of the most effective technical approaches to the various problems discussed. The electro-optics industry is so diverse and so rapidly growing that establishment of a consensus on the most appropriate solutions will challenge CORM participants, both industrial and governmental.

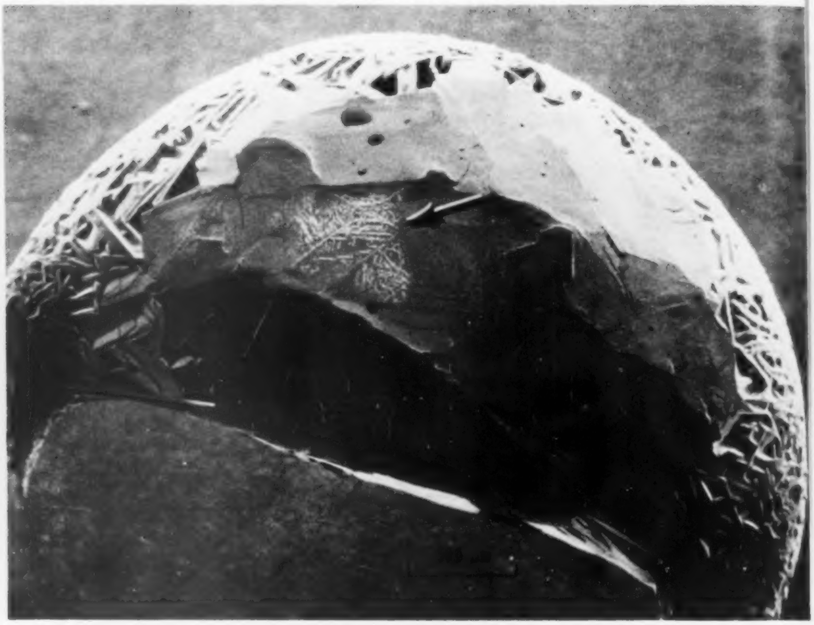
CIE NEWS

The Commission Internationale de l'Eclairage (CIE) has just announced that its Technical Committee 1.2 on Photometry will now be identified as Photometry and Radiometry. This change results from strong feeling on the Committee at its meeting in Barcelona last year that the two fields have now become inextricably intertwined.

[1] Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for cents. Use SD Catalog Number C13.46:594-2 when ordering.

[2] Technical Note series for Optical Radiation Measurements, Nat. Bur. Stand. (U.S.), Tech. News Bull. **56**, No. 6, 155 (1972).

The width of the dark spaces, noted by arrows, between magnified dendrites is measured in determining the resolution of scanning electron microscopes. The resolution represented in this NBS photomicrograph is approximately 220 angstroms.



NBS is proposing a new specimen to be used for determining the resolution of scanning electron microscopes. A dendrite formation is noted with an arrow on the surface of an aluminum-tungsten bead.

NEW RESOLUTION TEST SAMPLE FOR SCANNING ELECTRON MICROSCOPES

The dendritic crystal growth on the facets of an aluminum-tungsten bead[1] has been developed as a sample for testing the resolving capabilities of scanning electron microscopes (SEM). This material can be used in evaluating different SEM's and can aid in maintaining a SEM at its optimum resolution capability.

The development of this resolution test specimen in line with the Bureau's mission to maintain the highest degrees of reliability, accuracy, and uniformity among instruments, follows a study by D. B. Ballard of the various materials presently being used to check the resolution of SEM's.[2] Because the available samples did not fulfill many of the requirements for a test sample, Ballard examined other materials for a new specimen. This specimen, after consideration and evaluation by the ASTM and other concerned professional groups, can provide a basis for quantitative resolution testing.

Ballard was particularly interested in the fine steps of crystal facets on the aluminum-tungsten bead (the product of melting aluminum with a hot tungsten filament in a vacuum) that could be seen with an optical microscope. Upon further investigation with the SEM, fine microstructure was observed that suggested this sample as a candidate for use as a resolution test.

The sample is the result of an isothermal reversible reaction that occurs during the solidification of an aluminum-tungsten alloy melt: a peritectic reaction. Dendritic (finger-like) structures on the exposed crystal surface[1] have the following advantages required for an SEM test specimen: high secondary

emission, high contrast, allowance for accurate adjustment to the stigmator, varying structure spacing suitable for both high and low resolution testing, and reproducibility; no loose particles, outgassing, magnetism, or adverse reaction to the electron beam.

In order to determine instrument performance the photo must not be photographically enhanced or altered as such a process could bias true resolution measurements. Resolution measurements can be made by using the unaided eye and a millimeter scale directly on photomicrographs of magnified images of the dendritic structure. The smallest, well-defined, 1 mm dark space between two dendrites at the highest magnification possible can be used to measure the resolution of the particular SEM in question. As a possible day-to-day working resolution test, an operator can attempt to make a measurement of a well-defined, 1 mm space at a magnification of 20,000 times, to yield a resolution of 50 nm (500 angstroms). As further advancements are made to improve the accuracy in instrument magnification, then greater accuracies in measuring resolution may also follow.

The instrument's resolution capability is a deciding factor in obtaining a well-defined image of an object's surface, and hence an accurate analysis of its surface topography. Resolution is not, however, a single instrument parameter. Rather it is dependent upon specimen interactions with the electron beam, instrument parameters such as the size of the electron beam, electronic noise, and the resolving power of the recording system.

[1] Ballard, D. B., A resolution test sample for the scanning electron microscope, Proc. 30th Annual Meeting Electron Microscopy Society of America and First Pacific Regional Conference, Los Angeles, Calif., Aug. 14-18, 1972 (to be published by Claitor's Book Store, Baton Rouge, La.).

[2] Ballard, D. B., Comparison and evaluation of specimens for resolution standard, Proc. 5th Annual Scanning Electron Microscope Symposium, Part I, IIT Chicago, Ill., Apr. 25-26, 1972, p. 121 (Ed. Dr. Om Johari, Metals Research Division, IIT Research Institute, Chicago, Ill. 60616).

COMPUTERS *Continued*

the planning for economic or social development. One reason for this last-mentioned deficiency is that governments have not recognized ADP personnel as professionals within their civil service structures and consequently salary scales are much lower than those of industry.

One last observation: the potential for probable improvement in computer utilization and application is great but lack of sophisticated management training is a major barrier to the needed improvement. In addition, uncertain assignments of responsibility within the governments and internal bureaucratic dissention over computer support are obstacles to a successful program for the utilization of computer technology.

UNITED NATIONS ACTIVITY

The United States is not alone in its concern with more effective use of computers by emerging nations. The General Assembly to the U.N. recently instructed the Secretary General to investigate the role of computer technology in development and a study was prepared on "The Application of Computer Technology for Development." The U.N. is also continuing its investigative efforts, as evidenced by a series of recent international conferences concerning some phase of this general subject—an indication also that many individual countries have recognized its importance.

NSRDS *Continued*

and reviews the properties of leptons, mesons, and baryons. The annual compilation is the updating of the 1971 *Review of Particle Properties*, Particle Data Group (Rev. Mod. Phys. 43, No. 2, Supplement, S1, 1971). Data are evaluated, listed, averaged, and summarized in tables.

THERMOPHYSICAL PROPERTIES OF PARAHYDROGEN FROM THE FREEZING LIQUID LINE TO 5,000 R FOR PRESSURE TO 10,000 PSIA

NBS Technical Note 617, *Thermophysical Properties of Parahydrogen from the Freezing Liquid Line to 5,000 R for Pressures to 10,000 PSIA*, by R. D. McCarty and L. A. Weber[1] (SD Catalog No. C13.46:617, $1.50) is an exhaustive, critically evaluated listing of the best values available for the thermophysical properties of parahydrogen. The tables include entropy, enthalpy, internal energy, density, volume, speed of sound, specific heats, thermal conductivity, viscosity, thermal diffusivity, Prandtl number, dielectric constant, specific heat input, energy derivative, isothermal bulk modulus, volume expansivity, and the isothermal and isochoric derivatives of pressure with respect to volume and temperature. These tables are given for temperatures from the melting line to 5,000 R, and for pressures from 1 psia to 10,000 psia, with each table covering one of 65 isobars.

There are also tables of saturated vapor and liquid properties for all of the above plus surface tension, and tables for pressure and temperature of the freezing liquid, index of refraction, and the derived Joule-Thomson inversion curve. The paper also presents equations used to calculate the tables.

[1] Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for the price indicated.

they issue on behalf of their member governments. A parallel development can be seen in Eastern Europe through their organization CMEA—more commonly known as COMECON.

Another indication of the increasing emphasis on international standards as substitutes for national standards is the switch in the ISO program technically. While still the major part of our program concerns itself with test methods for materials (steel, plastics, rubber, textiles, paper, etc.), terminology, and other rather basic standards, the preparation of specifications, dimensional, and performance standards for products are now added at an accelerating speed. The addition of items of this character is bringing out many more national differences.

The difference most frequently referred to is, of course, the different measurement systems we still use in the industrial world. It must be borne in mind, however, that the fact that we operate two measurement systems does in itself not create problems in international standardization. It is the technological and industrial application, based on our liking of rounded-off values, that is causing the difficulties. However, I think it is important to remind ourselves from time to time that an automobile tire of 15-inch diameter does not change in size if you indicate the diameter as 380 mm.

One real difficulty in international standardization, which has nothing to do with the use of measurement systems, is what I like to call differences in "safety philosophy." You would think that what is considered safe in Belgium would be good for Holland and *vice versa*. But, in a number of instances, this is just not true. What is needed here is better collaboration between government agencies establishing minimum requirements for safety and standards organizations, and a better understanding on the part of governments of the need to change present national safety philosophies and adopt an international approach instead.

So, while until a few years ago international standardization was very much the concern of industry only—industry then as both producers and users which is sometimes forgotten—today governments are getting more and more involved, both as supporters of national standards bodies and as partners in intergovernmental organizations. But also other parties are showing an increasing interest in international standardization.

National delegations to ISO meetings frequently include consumer representatives. Some items of particular interest to the consumers now being studied within ISO are: sizing of clothes and shoes, furniture, watches, sports and recreation equipment, sewing machines, bicycles, carpets, and food products. In 1968, ISO, together with the International Electrotechnical Commission (IEC), set up the International Standards Steering Committee on Consumer Affairs, known as ISCA, which provides a meeting point for representatives of ISO, IEC, and the international consumer movement.

The founder members of ISO were principally developed countries. In the last 10 years, there has, however, been considerable growth in the number of developing countries which have joined ISO. ISO has two bodies dealing specifically with the application of standardization in developing countries:

- DEVCO (Development Committee), the members of which are representatives of ISO member bodies. DEVCO's program of work includes studies aimed at helping the developing countries to define their needs as regards standardization.
- DEVPRO (Standing Coordinating Bureau for the Promotion of Standardization in the Developing Countries), which provides an informal meeting point for representatives of the principal intergovernmental organizations concerned with assistance to developing countries to discuss the contribution which can be made by standardization to the solution of the problems of these countries.

In conclusion, ISO is facing not only the challenge of producing international standards at an accelerating speed, but future international standards must also be more complete than the ISO Recommendations prepared so far if ISO International Standards are to take the place of present national standards. Further, if technical barriers to trade are to be removed, ISO must work more closely with intergovernmental organizations and give priority to a number of items connected with technical regulations. The program for the technical work of ISO must constantly be adapted to technological changes. And then we must try to secure a fuller participation in the ISO work of countries that have joined ISO rather recently or not become active until lately.

But the participation must cover all the international work. It is not enough to pay attention only to items which are of immediate commercial interest. There are many rather basic or general items studied within ISO which form an important part of the total activity and which have long term implications. The ISO International Standards resulting from these studies are fundamental bricks when building other international standards, and unless you are contributing to the designing of these bricks, you will not have the proper influence on the remainder of the building.

ADDITIONAL INTERLABORATORY REFERENCE TESTS FOR PAPER AND RUBBER

The Bureau recently added eight paper tests and one rubber test to its continuing interlaboratory reference programs. In addition a new program on appearance properties was initiated in September. There are two immediate objectives of the overall programs: (1) to provide a means whereby a participating laboratory may periodically check the level and uniformity of its testing in comparison with that of other laboratories; and (2) to improve the reliability of test results both within and among laboratories.

PAPER

Two collaborative reference programs for paper have been administered for the past 3 years by NBS under the sponsorship of the Technical Association of the Pulp and Paper Industry (TAPPI) Standards Committee and the Fourdrinier Kraft Board Institute (FKI). The eight new additions to the paper program are: a stretch test and a tensile energy absorption test for printing paper; a stretch test and a tensile energy absorption test for packaging paper; IGT pick tests using standard oil and standard ink; a pH test; and a test for determining basis weight of paper.

Each participating laboratory selects one or more paper tests from among the total of 28 presently available. Two different samples of the type of paper required for a test, randomly selected from uniform lots of material, are periodically distributed to each participant. After carrying out the measurements specified for each test, the laboratory returns the test results to NBS along with other relevant information such as the test conditions and types of instruments used. The Bureau then analyzes the results and prepares a summary report to be sent to the participants the following month. All information regarding the identification of the participating laboratories is confidentially coded except for NBS data.

RUBBER

A new test on vulcanization characteristics of rubber brings to five the number of interlaboratory reference tests for rubber presently being offered by NBS. In accordance with procedures followed by the American Society for Testing and Materials, standard ASTM sheets of rubber are sent to each participant. The participants then test each sheet in accordance with the appropriate ASTM procedure, and send the results to NBS for analysis. A preliminary report, summarizing the results, is prepared for each program and sent to each participant in that program. A more complete report, covering all five tests is distributed at the end of each quarter.

APPEARANCE

Under the sponsorship of the Manufacturers Council on Color and Appearance, a new program on appearance properties will be made available in September to the paint, plastics, paper, and other industries interested in color and appearance. The new program will be initiated with two types of measurements: 60 degree gloss; and color and color difference. The program will involve the distribution each quarter of four different color chips and two different gloss samples. The confidential coding of the laboratories and the preparation and distribution of reports will be essentially the same as for the paper and rubber programs.

Further information regarding the overall programs may be obtained by contacting:

Dr. T. W. Lashof
Collaborative Reference Programs
Room B360—Polymer Building
National Bureau of Standards
Washington, D.C. 20234
Tel. (301) 921-2983

3-23-73
/LL

UNITED STATES
GOVERNMENT PRINTING OFFICE
PUBLIC DOCUMENTS DEPARTMENT
WASHINGTON, D.C. 20402

OFFICIAL BUSINESS

POSTAGE AND FEES PAID
U.S. GOVERNMENT PRINTING OFFICE

U.S.MAIL

TN DEC RMP
MAYO CLINIC LIB
200 FIRST ST S W
ROCHESTER MN 55901

PUBLICATIONS of the National Bureau of Standards*

PERIODICALS

Technical News Bulletin, Annual subscription: Domestic, $3; foreign, $4. Single copy price, 30 cents. Available on a 1-, 2-, or 3-year subscription basis. SD Catalog No. C13.13.

Journal of Research of the National Bureau of Standards

Section A. Physics and Chemistry. Issued six times a year. Annual subscription: Domestic, $9.50; foreign, $11.75. Single copy price varies. SD Catalog No. C13.22/sec.A.

Section B. Mathematical Sciences. Issued quarterly. Annual subscription: Domestic, $5; foreign, $6.25. Single copy, $1.25. SD Catalog No. C13.22/sec.B.

Section C. Engineering and Instrumentation. Issued quarterly. Annual subscription: Domestic, $5; foreign, $6.25. Single copy, $1.25. SD Catalog No. C13.22/sec.C.

NBS BIBLIOGRAPHIC SUBSCRIPTION SERVICES

Cryogenic Data Center Current Awareness Service (Publications and Reports of Interest in Cryogenics). A literature survey issued weekly. Annual subscription: Domestic, $20.00; foreign, $25.00.

Liquefied Natural Gas. A literature survey issued quarterly. Annual subscription: $20.00.

Superconducting Devices and Materials. A literature survey issued quarterly. Annual subscription: $20.00. Send subscription orders and remittances for the preceding bibliographic services to the U.S. Department of Commerce, National Technical Information Service, Springfield, Va. 22151.

Electromagnetic Metrology Current Awareness Service (Abstracts of Selected Articles on Measurement Techniques and Standards of Electromagnetic Quantities from D-C to Millimeter-Wave Frequencies). Issued monthly. Annual subscription: $100.00 (Special rates for multi-subscriptions). Send subscription order and remittance to the Electromagnetic Metrology Information Center, Electromagnetics Division, National Bureau of Standards, Boulder, Colo. 80302.

CURRENT ISSUES OF THE JOURNAL OF RESEARCH

J. Res. Nat. Bur. Stand. (U.S.), **76A** *(Phys. & Chem.)*, No. 2, (March—April 1972), SD Catalog No. C13.22/sec. A:76/2.

Brown, J. E., The characterization of linear polyethylene SRM 1475. III. Density determination.

Maurey, J. R., The characterization of linear polyethylene SRM 1475. IV. Melt flow rate.

Christensen, R. G., The characterization of linear polyethylene SRM 1475. V. Solution viscosity measurements.

Christensen, R. G., The characterization of linear polyethylene SRM 1475. VI. Preparation of calibrating fractions.

Wagner, H. L., The characterization of linear polyethylene SRM 1475. VII. Differential refractive index of polyethylene solutions.

Frolen, L. J., Ross, G. S., Wims, A. M., and Verdier, P. H., The characterization of linear polyethylene SRM 1475. VIII. Light-scattering studies on polyethylenes in 1-chloronaphthalene.

Brown, J. E., and Verdier, P. H., The characterization of linear polyethylene SRM 1475. IX. Number average molecular weight of fractions by membrane osmometry.

Ross, G., and Frolen, L., The characterization of linear polyethylene SRM 1475. X. Gel permeation chromatography.

J. Res. Nat. Bur. Stand. (U.S.), **76A** *(Phys. & Chem.)*, No. 3, (May–June 1972), SD Catalog No. C13.22/sec.A:76/3.

Sparks, L. L., and Powell, R. L., Low temperature thermocouples: KP, "normal" silver, and copper versus Au-0.02 at% Fe and Au-0.07 at% Fe.

Verges, J., Corliss, C. H., and Martin, W. C., Infrared spectra of cerium (Ce I and Ce II) between 0.8 and 2.4 μm.

Hamer, W. J., Thermodynamics of standard cells of the saturated cadmium sulfate type.

Verbeke, O. B., An improved state equation in the vicinity of the critical point.

Sanchez, I. C., and DiMarzio, E. A., Dilute solution theory of polymer crystal growth: Fractionation effects.

Khoury, F., and Barnes, J. D., The formation of curved polymer crystals: Poly(4-methylpentene-1).

Sieck, L. W., and Ausloos, P., Photoionization of propylene, cyclopropane, and ethylene. The effect of internal energy on the bimolecular reactions of $C_2H_4^+$ and $C_3H_6^+$.

**Publications with prices and SD Catalog numbers indicated may be purchased directly from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (foreign: one-fourth additional). NBS nonperiodical series are also available from the National Technical Information Service (NTIS), Springfield, Va., 22151 (formerly the Clearinghouse for Federal Scientific and Technical Information). Reprints from outside journals and the NBS Journal of Research may often be obtained directly from the authors by title only.*